

Dear student following is a Moderate level [00●00] test paper. Score of 15 Marks in 10 Minutes would be a satisfactory performance. Questions 1-10 (+3, -1). (All Questions have Single Options correct)

**Q.1** A stone is just released from the window of a train moving along a horizontal straight track. The stone will hit the ground following  
 (A) Straight path (B) Circular path  
 (C) Parabolic path (D) Hyperbolic path

**Q.2** A bomb is dropped from an aeroplane moving horizontally at constant speed. When air resistance is taken in consideration, the bomb  
 (A) Falls to earth exactly below the aeroplane  
 (B) Falls to earth behind the aeroplane  
 (C) Falls to earth ahead of the aeroplane  
 (D) Flies with the aeroplane

**Q.3** If the initial velocity of a projectile be doubled, keeping the angle of projection same, the maximum height reached by it will  
 (A) Remain the same (B) Be doubled  
 (C) Be quadrupled (D) Be halved

**Q.4** The height and the distance  $x$  along the horizontal plane of a projectile on a certain planet (with no atmosphere) are given by  $y = (8t - 5t^2)m$  and  $x = 6t m$ , where  $t$  is in second. The angle with the horizontal at which the projectile was projected is  
 (A)  $\tan^{-1} (3/4)$  (B)  $\tan^{-1} (4/3)$   
 (C)  $\sin^{-1} (3/4)$  (D)  $\cos^{-1} (3/4)$

**Q.5** A particle is projected with a velocity  $u$  so that its horizontal range is twice the greatest height attained. The horizontal range is  
 (A)  $u^2 / g$  (B)  $2u^2 / 3g$   
 (C)  $4u^2 / 5g$  (D) None of these

**Q.6** A particle is thrown with a speed  $u$  at an angle  $\theta$  with the horizontal. When the particle makes an angle  $\phi$  with the horizontal. its speed changes to  $v$ , which is equal to  
 (A)  $u \cos \theta$  (B)  $u \cos \theta \cos \phi$   
 (C)  $u \cos \theta \sec \phi$  (D)  $u \sec \theta \cos \phi$

**Q.7** The maximum height attained by a projectile is increased by 10% by increasing its speed of projection, without changing the angle of projection. The percentage increase in the horizontal range will be  
 (A) 20% (B) 15% (C) 10% (D) 5%

**Q.8** A body is projected at time  $t = 0$  from a certain point on a planet's surface with a certain velocity at a certain angle with the planet's surface (assumed horizontal). The horizontal and vertical displacement  $x$  and  $y$  (in meters) respectively vary with time  $t$  (in seconds) as

$$x = 10\sqrt{3}t, \quad y = 10t - t^2$$

What is the magnitude and direction of the velocity with which the body is projected ?  
 (A)  $20\text{ms}^{-1}$  at an angle of  $30^\circ$  with the horizontal  
 (B)  $20\text{ms}^{-1}$  at an angle of  $60^\circ$  with the horizontal  
 (C)  $10\text{ms}^{-1}$  at an angle of  $30^\circ$  with the horizontal  
 (D)  $10\text{ms}^{-1}$  at an angle of  $60^\circ$  with the horizontal

The following questions consist of two statements one labelled Assertion (A) and the another labelled Reason (R). Select the correct answers to these questions from the codes given below :

- (A) Both A and R are true and R is the correct explanation of A.
- (B) Both A and R are true but R is not correct explanation of A
- (C) A is true but R is false
- (D) A is false but R is true.

**Q.9 Assertion :** At the highest point of its path, a projectile has only vertical component of velocity.

**Reason :** At the highest point, only the horizontal component of velocity persists.

**Q.10 Assertion :** When a body is dropped or thrown horizontally from the same height, it would reach the ground at the same time.

**Reason :** Horizontal velocity has no effect in the vertical direction.

**PHYSICS IIT JEE (JUNE 3<sup>rd</sup> WEEK CLASS TEST 4) (TWO-D MOTION) ANSWER KEY**

Name : ..... Roll No. : .....

	A	B	C	D		A	B	C	D		A	B	C	D
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
										10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**ANSWER KEY**

<b>Que.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Ans.</b>	C	B	C	B	C	C	C	A	D	A

## SOLUTIONS

**Sol.1 (C)**

Due to constant velocity along horizontal and vertical downward force of gravity stone will hit the ground following parabolic path.

**Sol.2 (B)**

Due to air resistance, it's horizontal velocity will decrease so it will fall behind the aeroplane.

**Sol.3 (C)**

$$H = \frac{u^2 \sin^2 \theta}{2g}$$

$$\therefore H \propto u^2.$$

If initial velocity be doubled then maximum height reached by the projectile will quadruple.

**Sol.4 (B)**

Let  $u$  be the initial velocity of projection and  $\theta$  be the angle of projection. Then horizontal displacement,

$$x = u \cos \theta t \quad \dots(i)$$

Vertical displacement,

$$y = u \sin \theta t - \frac{1}{2}gt^2 \quad \dots(ii)$$

comparing (i) and (ii) with the given relations,

$$x = 6t \text{ and } y = 8t - 5t^2,$$

we have,

$$u \cos \theta = 6; u \sin \theta = 8 \text{ and } \frac{1}{2}g = 5.$$

Therefore, angle of projection,

$$\tan \theta = \frac{u \sin \theta}{u \cos \theta} = \frac{8}{6} = \frac{4}{3}$$

$$\text{or } \theta = \tan^{-1} \frac{4}{3}$$

**Sol.5 (C)**

Horizontal range,  $R = \frac{u^2 \sin 2\theta}{g};$

Max. height,  $H = \frac{u^2 \sin^2 \theta}{2g}$

As per question,  $R = 2H$

$$\therefore \frac{u^2 \sin 2\theta}{g} = \frac{2u^2 \sin^2 \theta}{2g}$$

or  $\sin 2\theta = \sin^2 \theta$

or  $2 \sin \theta \cos \theta = \sin^2 \theta.$

or  $\tan \theta = 2$

Hence  $\sin \theta = \left(\frac{2}{\sqrt{5}}\right)$

and  $\cos \theta = \left(\frac{1}{\sqrt{5}}\right)$

Horizontal range =  $\frac{2u^2 \sin \theta \cos \theta}{g}$

$$= \frac{2u^2}{g} \left(\frac{2}{\sqrt{5}}\right) \left(\frac{1}{\sqrt{5}}\right) = \frac{4u^2}{5g}$$

**Sol.6 (C)**

In projectile motion, the horizontal component velocity remains constant throughout the motion,

so  $u \cos \theta = v \cos \phi$

or  $v = u \cos \theta / \cos \phi = u \cos \theta \sec \phi$

**Sol.7 (C)**

We know that  $h = \frac{v_0^2 \sin^2 \theta}{2g}$ . The increase

$\delta h$  in  $h$  when  $v_0$  changes by  $\delta v_0$  can be obtained by partially differentiating this expression. Thus

$$\delta h = \frac{2v_0 \delta v_0 \sin^2 \theta}{2g},$$

$$\therefore \frac{\delta h}{h} = \frac{2\delta v_0}{v_0}$$

Since  $h$  is increased by 10%,  $\frac{\delta h}{h} = 0.1.$

Therefore,  $\frac{2\delta v_0}{v_0} = 0.1.$

Now, range  $R = \frac{v_0^2 \sin 2\theta}{g}$

Therefore,

$$\delta R = \frac{2v_0 \delta v_0 \sin 2\theta}{g}$$

$$\therefore \frac{\delta R}{R} = \frac{2\delta v_0}{v_0} = 0.1$$

Thus  $\delta R = 0.1R$ .

Hence R also increases by 10%.

we have,

$$v_0 \sin \theta = 10^{-1}.$$

These equations give

$$v_0^2 = 10^2 + 10^2 \times 3 = 400$$

or  $v_0 = 20 \text{ ms}^{-1}$

and  $\tan \theta = \frac{1}{\sqrt{3}}$  which gives  $\theta = 30^\circ$ .

**Sol.8 (A)**

We know that the position coordinates x and y are given by

$$x = (v_0 \cos \theta)t \quad \dots(i)$$

$$\text{and } y = (v_0 \sin \theta)t - \frac{1}{2}gt^2 \quad \dots(ii)$$

Comparing eq. (i) with  $x = 10\sqrt{3}t$ ,

we have,

$$v_0 \cos \theta = 10\sqrt{3} \text{ ms}^{-1}$$

Also, comparing eq. (ii) with  $y = 10t - t^2$ ,

**Sol.9 (D)**

At the highest point, vertical compT. of velocity becomes zero. only horizontal compT. remains.

**Sol.10 (A)**

Horizontal velocity provides the horizontal range. It does not affect time taken in the vertical direction.